2024

Name_____

Combined Science

Foundation

Chemistry: Paper 1

The Periodic Table of Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[97] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[267] **Rf** rutherfordium 104	[270] **Db** dubnium 105	[269] **Sg** seaborgium 106	[270] **Bh** bohrium 107	[270] **Hs** hassium 108	[278] **Mt** meitnerium 109	[281] **Ds** darmstadtium 110	[281] **Rg** roentgenium 111	[285] **Cn** copernicium 112	[286] **Nh** nihonium 113	[289] **Fl** flerovium 114	[289] **Mc** moscovium 115	[293] **Lv** livermorium 116	[293] **Ts** tennessine 117	[294] **Og** oganesson 118

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

* The Lanthanides (atomic numbers 58 – 71) and the Actinides (atomic numbers 90 – 103) have been omitted.

Relative atomic masses for **Cu** and **Cl** have not been rounded to the nearest whole number.

AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
COMBINED SCIENCE: TRILOGY

F

Foundation Tier
Chemistry Paper 1F

Thursday 16 May 2019 Morning Time allowed: 1 hour 15 minutes

Materials
For this paper you must have:
- a ruler
- a scientific calculator
- the periodic table (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Do not write outside the box

0 1 This question is about energy changes.

0 1 . 1 Which of these items uses an endothermic reaction?

[1 mark]

Tick (✓) **one** box.

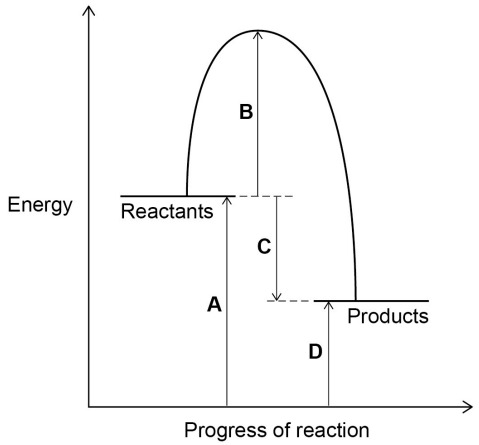
Hand warmer ☐

Sports injury pack ☐

Self-heating can ☐

Figure 1 shows the reaction profile for an exothermic reaction.

Figure 1



0 1 . 2 Which letter represents the activation energy for the reaction?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 3 Which letter represents the overall energy change for the reaction?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

lower than	**the same as**	**higher than**

In an exothermic reaction the energy of the products

is _____ the energy of the reactants.

0 1 . 5 A student measured the temperature at the start and at the end of a reaction.

Name the apparatus used to measure the temperature.

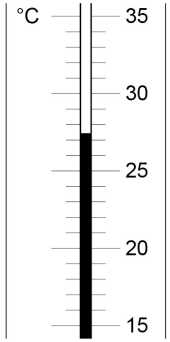
[1 mark]

_____

Question 1 continues on the next page

0 1 . 6 **Figure 2** shows the temperature at the end of the reaction.

Figure 2



Complete **Table 1.**

Use **Figure 2.**

[2 marks]

Table 1

Temperature at start in °C	14.3
Temperature at end in °C	
Change in temperature in °C	

7

Do not write outside the box

0 2 This question is about salts and electrolysis.

A student wants to make copper chloride crystals.

The student adds excess copper oxide to some hot acid.

The student stirs the mixture.

0 2 . 1 Which acid should the student use?

[1 mark]

Tick (✓) **one** box.

- Hydrochloric acid ☐
- Nitric acid ☐
- Sulfuric acid ☐

0 2 . 2 Suggest how the student would know that excess copper oxide has been added.

[1 mark]

_____

_____

Question 2 continues on the next page

Do not write outside the box

0 2 . 3 There are four more stages, **A**, **B**, **C** and **D**, to make copper chloride crystals.

The stages **A**, **B**, **C** and **D** are not in the correct order.

Stage **A**	Partially evaporate by heating with a water bath
Stage **B**	Filter the mixture into an evaporating basin
Stage **C**	Leave to crystallise
Stage **D**	Remove and dry the crystals

Put stages **A**, **B**, **C** and **D** in the correct order.

[2 marks]

First stage _____

Second stage _____

Third stage _____

Fourth stage _____

0 2 . 4 Molten copper chloride can be electrolysed.

State the product at each electrode when molten copper chloride is electrolysed.

[2 marks]

Negative electrode _____

Positive electrode _____

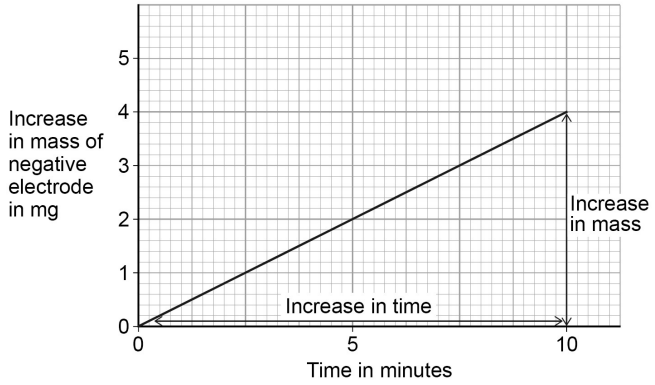
Do not write outside the box

0 2 . 5 A solution of copper chloride is electrolysed.

Figure 3 shows a graph of the increase in mass of the negative electrode.

This increase is shown over a time of 10 minutes.

Figure 3



Calculate the gradient of the line in **Figure 3.**

Use the equation:

$$\text{Gradient} = \frac{\text{increase in mass in mg}}{\text{increase in time in minutes}}$$

[3 marks]

Increase in mass _____

_____

Increase in time _____

_____

Gradient _____

_____

_____

_____

Gradient = _____ mg per minute

Turn over ►

Do not write outside the box

0 2 . 6 Aluminium is produced by electrolysis of a molten mixture.

Complete the sentence.

Choose the answers from the box.

[2 marks]

carbon	**chloride**	**cryolite**	**oxide**	**sulfate**	**water**

The molten mixture contains _____ and

aluminium _____ .

11

Do not write outside the box

0 3 This question is about the periodic table and argon.

0 3 . 1 What order did scientists use to arrange elements in early periodic tables?

[1 mark]

Tick (✓) **one** box.

- Atomic weight of element ☐
- Number of neutrons in an atom of element ☐
- Size of atoms of element ☐
- Year element was discovered ☐

0 3 . 2 In early periodic tables some elements were placed in the wrong groups.

Mendeleev overcame some of these problems in his periodic table.

Complete the sentence.

[1 mark]

Mendeleev did this by leaving _____ for elements that had not been discovered.

Question 3 continues on the next page

Do not write outside the box

0 3 . 3 What is the name of the group that contains argon?

[1 mark]

Tick (✓) **one** box.

- Alkali metals ☐
- Halogens ☐
- Noble gases ☐

0 3 . 4 An atom of argon is represented as $^{40}_{18}Ar$

Determine the number of protons and the number of neutrons in one atom of argon.

[2 marks]

Number of protons _____

Number of neutrons _____

0 3 . 5 Different atoms of argon are, $^{39}_{18}Ar$ and $^{38}_{18}Ar$

What is the name given to these different atoms of argon?

[1 mark]

Tick (✓) **one** box.

- Fullerenes ☐
- Ions ☐
- Isotopes ☐
- Molecules ☐

Do not write outside the box

0 3 . 6 What is the electronic structure of an argon atom, $^{40}_{18}Ar$?

[1 mark]

Tick (✓) **one** box.

2 ☐ 2, 8 ☐ 2, 8, 2 ☐ 2, 8, 8 ☐

0 3 . 7 Why is argon unreactive?

[1 mark]

_____

_____

8

Turn over for the next question

Do not write outside the box

0 4 This question is about Group 1 elements.

0 4 . 1 Sodium reacts with chlorine to produce sodium chloride.

Balance the equation for the reaction.

[1 mark]

_____ $Na + Cl_2 \rightarrow$ _____ $NaCl$

0 4 . 2 4.6 g of sodium reacts with chlorine to produce 11.7 g of sodium chloride.

What mass of chlorine reacted?

[1 mark]

_____

_____

Mass of chlorine = _____ g

0 4 . 3 A teacher puts hot sodium into a gas jar of chlorine.

The changes seen before, during and after this reaction were observed.

Complete the sentences.

Choose the answers from the box.

[4 marks]

colourless	**green**	**lilac**	**silver**	**white**	**yellow**

Sodium is a _____ solid.

Chlorine is a _____ gas.

The hot sodium burns with a _____ flame.

The product sodium chloride is a _____ solid.

Do not write outside the box

0 4 . 4 Sodium chloride (NaCl) is an ionic compound.

Write the formulae of the ions in sodium chloride.

[2 marks]

Sodium ion _____

Chloride ion _____

0 4 . 5 Complete the sentence.

Choose the answer from the box.

[1 mark]

an atom	an electron	a neutron	a proton

Potassium is more reactive than sodium.

This is because potassium loses _____ more easily than sodium.

0 4 . 6 How does the size of a potassium atom compare with the size of a sodium atom?

Give a reason for your answer.

[2 marks]

_____

Reason _____

_____

_____

11

Turn over for the next question

Do not write outside the box

0 5 This question is about oxygen and compounds of oxygen.

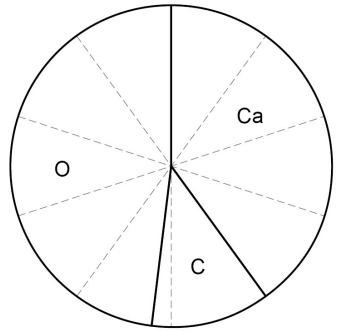
0 5 . 1 What is the state symbol of oxygen at room temperature?

[1 mark]

_____

0 5 . 2 **Figure 4** shows the percentage by mass of the elements calcium, carbon and oxygen in calcium carbonate.

Figure 4



What is the percentage by mass of calcium in calcium carbonate?

[1 mark]

_____

Percentage = _____ %

0 5 . 3 At high temperature, sodium nitrate decomposes into sodium nitrite and oxygen.

A student heats three samples of sodium nitrate.

The mass of each sample was 4.50 g

The mass of solid after heating was recorded.

Table 2 shows the mass of solid after heating in each experiment.

Table 2

Experiment	Mass of solid after heating in g
1	3.76
2	3.98
3	4.09

Calculate the mean mass of solid after heating.

Give your answer to 3 significant figures.

[3 marks]

Mean mass of solid after heating = _____ g

Question 5 continues on the next page

0 5 . 4 **Table 3** shows the electronic structure of hydrogen and oxygen.

Table 3

Element	Electronic structure
Hydrogen	1
Oxygen	2,6

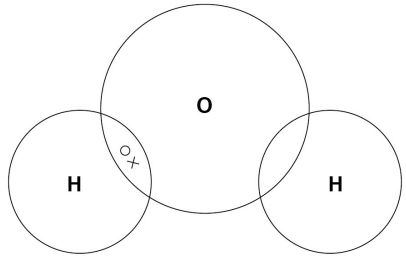
Figure 5 shows part of a dot and cross diagram of a molecule of water (H_2O).

Complete the dot and cross diagram.

You should show only the electrons in the outer energy levels.

[2 marks]

Figure 5



Oxygen and sulfur are examples of simple molecules.

0 5 . 5 Complete the sentence.

Choose the answer from the box.

[1 mark]

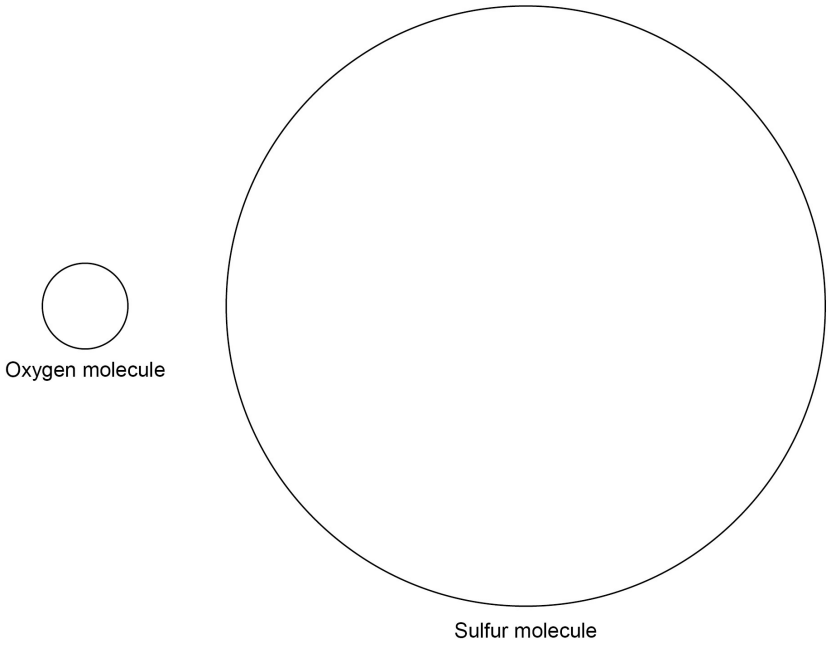
covalent	ionic	metallic

There are _____ bonds between the atoms of oxygen in an oxygen molecule.

Do not write outside the box

0 5 . 6 **Figure 6** shows the relative sizes of an oxygen molecule and a sulfur molecule.

Figure 6



How does the boiling point of sulfur compare with the boiling point of oxygen?

Complete the sentences.

[2 marks]

The boiling point of sulfur is _____ the boiling point of oxygen.

This is because in sulfur the intermolecular forces are _____

than the intermolecular forces in oxygen.

10

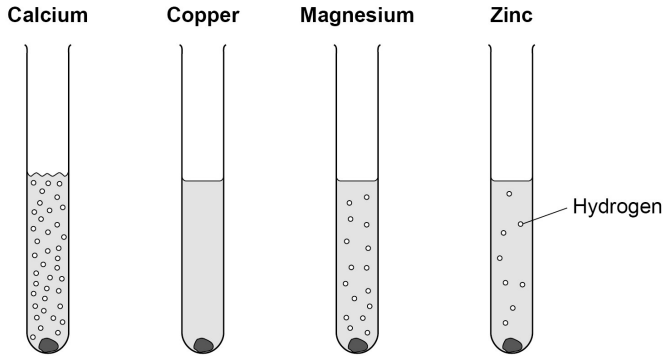
Turn over ►

Do not write outside the box

0 6 This question is about reactions of metals.

Figure 7 shows what happens when calcium, copper, magnesium and zinc are added to hydrochloric acid.

Figure 7



0 6 . 1 What is the order of decreasing reactivity of these four metals?

[1 mark]

Tick (✓) **one** box.

Zn Ca Cu Mg ☐

Ca Cu Mg Zn ☐

Cu Zn Ca Mg ☐

Ca Mg Zn Cu ☐

Do not write outside the box

A student wants to make a fair comparison of the reactivity of the metals with hydrochloric acid.

0 6 . 2 Name **two** variables that must be kept constant.

[2 marks]

1 _____

_____

2 _____

_____

0 6 . 3 What is the independent variable in this reaction?

[1 mark]

_____

_____

0 6 . 4 Predict the reactivity of beryllium compared with magnesium.

Give a reason for your answer.

Use the periodic table.

[2 marks]

_____

Reason _____

_____

_____

0 6 . 5 A solution of hydrochloric acid contains 3.2 g of hydrogen chloride in 50 cm^3

Calculate the concentration of hydrogen chloride in g per dm^3

[3 marks]

_____

_____

_____

_____

Concentration = _____ g per dm^3

9

Turn over ►

Do not write outside the box

0 7 This question is about salts.

Ammonium nitrate solution is produced when ammonia gas reacts with nitric acid.

0 7 . 1 Give the state symbol for ammonium nitrate solution.

[1 mark]

_____

0 7 . 2 What is the formula of nitric acid?

[1 mark]

Tick (✓) **one** box.

HCl ☐

HNO_3 ☐

H_2SO_4 ☐

NH_4OH ☐

0 7 . 3 Ammonia gas dissolves in water to produce ammonia solution.

Ammonia solution contains hydroxide ions, OH^-

A student adds universal indicator to solutions of nitric acid and ammonia.

What colour is observed in each solution?

[2 marks]

Colour in nitric acid _____

Colour in ammonia solution _____

Do not write outside the box

0 7 . 4 The student gradually added nitric acid to ammonia solution.

Which row, **A**, **B**, **C** or **D**, shows the change in pH as the nitric acid is added until in excess?

[1 mark]

Tick (✓) **one** box.

	pH of ammonia solution at start	pH after addition of excess nitric acid	
A	10	7	
B	2	10	
C	7	1	
D	10	2	

0 7 . 5 Calculate the percentage by mass of oxygen in ammonium nitrate (NH_4NO_3).

Relative atomic masses (A_r): H = 1 N = 14 O = 16

Relative formula mass (M_r): NH_4NO_3 = 80

[3 marks]

Percentage by mass of oxygen = _____ %

Question 7 continues on the next page

Do not write outside the box

0 7 . 6 Describe a method to investigate how the temperature changes when different masses of ammonium nitrate are dissolved in water.

You do **not** need to write about safety precautions.

[6 marks]

14

END OF QUESTIONS

Do not write outside the box

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DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

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ANSWER IN THE SPACES PROVIDED

AQA

GCSE
COMBINED SCIENCE: TRILOGY
8464/C/1F

Chemistry Paper 1F

Mark scheme

June 2019

Version: 1.0 Final

I96G8464cIf/MS

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	sports injury pack		1	AO1 5.5.1.1
01.2	B		1	AO1 5.5.1.2
01.3	C		1	AO1 5.5.1.2
01.4	lower than		1	AO1 5.5.1.2
01.5	thermometer		1	AO1 5.5.1.2
01.6	27.4 (°C) (27.4–14.3 =) 13.1 (°C)	allow values in the range 27.2–27.5 (°C) allow correct subtraction of incorrect temperature reading	1 1	AO2 5.5.1.1
Total			**7**	

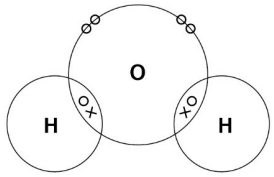
Question	Answers	Extra information	Mark	AO / Spec.
02.1	hydrochloric acid		1	AO1 5.4.2.3
02.2	(black) solid remains (after stirring)	allow copper oxide remains allow no more copper oxide reacts	1	AO1 5.4.2.3
02.3	first stage **B** second stage **A** third stage **C** fourth stage **D**	all 4 correct for **2** marks allow **1** mark if either first stage or fourth stage is correct	2	AO1 5.4.2.3
02.4	(negative electrode) copper (positive electrode) chlorine	allow Cu allow Cl_2 / Cl do **not** accept chloride or Cl^- if no other mark awarded allow **1** mark if elements are reversed	1 1	AO2 5.4.3.2

02.5	a reading of an increase in mass correct linked reading of the increase in time correct evaluation of gradient	e.g. 4 (mg) in 10 (mins) scores 2 marks e.g. ($\frac{4}{10}$ =) 0.4 (mg per min) allow correct calculation of gradient from incorrectly determined values for mass and/or time	1 1 1	AO2 5.4.3.4
02.6	cryolite oxide	this order only	1 1	AO1 5.4.3.3
Total			**11**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	atomic weight of element		1	AO1 5.1.2.2
03.2	gaps	allow spaces / blanks do **not** accept undiscovered elements	1	AO1 5.1.2.2
03.3	noble gases		1	AO1 5.1.2.4
03.4	18 22	this order only	1 1	AO2 5.1.1.5
03.5	isotopes		1	AO1 5.1.1.5
03.6	2,8,8		1	AO2 5.1.1.5
03.7	stable arrangement (of electrons)	allow full outer shell allow eight electrons in the outer shell allow does not need to gain or lose electrons	1	AO1 5.1.2.4
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	2 Na + Cl_2 → 2 NaCl	allow multiples	1	AO1 5.1.2.2
04.2	7.1 (g)		1	AO2 5.3.1.1
04.3	silver green yellow white	this order only allow yellow allow white	1 1 1 1	AO1 5.1.2.5
04.4	Na^+ Cl^-	if no other mark awarded allow **1** mark for +(1) charge for sodium ion and –(1) charge for chloride ion	1 1	AO1 5.2.1.2
04.5	an electron		1	AO2 5.1.2.5

04.6	potassium (atom) is larger potassium (atom) has more energy levels (of electrons) **or** potassium (atom) has more shells (of electrons)	allow converse for sodium mark independently do **not** accept more outer shells	1 1	AO2 5.1.2.1 & 5.1.2.5
Total			**11**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	(g)	allow g ignore formulae	1	AO1 5.2.2.2
05.2	40 (%)		1	AO2 5.1.1.1
05.3	$\frac{3.76 + 3.98 + 4.09}{3}$ **or** $\frac{11.83}{3}$ = 3.943(33333333333333333) = 3.94 (g)	an answer of 3.94 (g) scores **3** marks allow a correctly written answer to 3 significant figures from an incorrectly calculated mean	1 1 1	AO2 5.3.1.3
05.4	one shared pair in each overlap 4 non-bonding electrons in outer shell of oxygen	allow combination of circles, dots, crosses or $e^{(-)}$ do **not** accept extra electron(s) on outer shell of hydrogen ignore any inner shell electrons  diagram scores 2 marks	1 1	AO1 5.2.1.4

05.5	covalent		1	AO1 5.2.2.1 5.2.2.4

05.6	higher (than) stronger (than between oxygen molecules)		1 1	AO2 5.2.2.4

Total			**10**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	Ca Mg Zn Cu		1	AO3 5.4.1.2
06.2	any **two** from: • mass (of metal / element) • surface area (of metal / element) • concentration (of acid) • volume (of acid) • temperature (of acid)	 allow weight ignore size ignore length ignore pH ignore strength ignore room temperature	2	AO3 5.4.1.2
06.3	(type of) metal / element		1	AO2 5.4.1.2

06.4	(beryllium is) less reactive any **one** from: • greater attraction between nucleus and outer electrons • more energy is needed to remove electrons • loss of electrons is more difficult • outer electrons closer to nucleus • less shielding	allow converse answers for magnesium MP2 only if MP1 is correct allow higher in group allow reactivity increases down the group ignore reactivity series	1 1	AO3 5.1.2.3 5.1.2.5 5.4.1.2

06.5	$\frac{50}{1000}$ (dm^3) = 0.05 (dm^3) ($\frac{3.2}{0.05}$) = 64 (g per dm^3) **alternative approach:** $\frac{3.2}{50}$ (1) = 0.064 (1) (× 1000) = 64 (g per dm^3) (1) **alternative approach**: $\frac{1000}{50}$ (1) = 20 (1) (× 3.2) = 64 (g per dm^3) (1)	an answer of 64 (g per dm^3) scores **3** marks an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps an answer of 0.16 / 0.064 / 0.64 / 6.4 / 6.4 × 10^{-5} (g per dm^3) gains **2** marks	 1 1 1	AO2 5.3.2.5
Total			**9**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	(aq)	allow aq ignore aqueous ignore formulae	1	AO1 5.2.2.2
07.2	HNO_3		1	AO1 5.1.1.1 5.4.2.2
07.3	red purple **or** blue	allow orange or yellow do **not** accept green allow shades of purple e.g. violet	1 1	AO1 5.4.2.4
07.4	D		1	AO3 5.4.2.4
07.5	 3 × 16 **or** 48 $\frac{48}{80}$ (×100) 60 (%)	an answer of 60 (%) scores **3** marks an answer of 20 (%) scores **2** marks for: $\frac{16}{80}$ (× 100) (1) = 20 (%) (1)	 1 1 1	AO2 5.3.1.2

Question	Answers	Mark	AO/ Spec. Ref
07.6	**Level 3:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO3 AO2
	Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	5.5.1.1
	Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content **Steps** • use a suitable container e.g. test tube • use insulation • add water • measure the initial water temperature (with a thermometer) • add stated mass e.g. 1g **or** 1 spatula • stir (to dissolve the solid) • measure the final (allow lowest or highest) temperature of the solution • calculate the temperature difference **or** determine graphically • repeat with different masses • repeat with the same volume of water to access level 3 there must be an indication of how the temperature change is determined using different masses dissolved in the same quantity of water		
Total			**14**

AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: TRILOGY

F

Foundation Tier
Chemistry Paper 1F

Time allowed: 1 hour 15 minutes

Materials
For this paper you must have:
- a ruler
- a scientific calculator
- the periodic table (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Do not write outside the box

0 1 Magnesium is in Group 2 of the periodic table.

1.0 g of magnesium reacted with chlorine to produce magnesium chloride.

0 1 . 1 Which types of element react when magnesium reacted with chlorine?

[1 mark]

Tick (✓) **one** box.

A metal and a metal ☐

A metal and a non-metal ☐

A non-metal and a non-metal ☐

0 1 . 2 Write the word equation for the reaction when magnesium reacts with chlorine.

[1 mark]

_____ + _____ → _____

0 1 . 3 What apparatus was used to measure the mass of 1.0 g of magnesium?

[1 mark]

Tick (✓) **one** box.

Balance ☐

Beaker ☐

Ruler ☐

Do not write outside the box

0 1 . 4 What mass of magnesium chloride was produced?

[1 mark]

Tick (✓) **one** box.

Less than 1.0 g ☐

1.0 g ☐

More than 1.0 g ☐

0 1 . 5 Magnesium reacts with oxygen to produce magnesium oxide.

Calculate the percentage mass of magnesium in magnesium oxide (MgO).

Relative atomic mass (A_r): Mg = 24

Relative formula mass (M_r): MgO = 40

[2 marks]

Percentage mass of magnesium = _____ %

Question 1 continues on the next page

Do not write outside the box

Magnesium carbonate decomposes to produce magnesium oxide and carbon dioxide.

The word equation for the reaction is:

magnesium carbonate → magnesium oxide + carbon dioxide

Four students heated 2.00 g of magnesium carbonate for 10 minutes.

Table 1 shows the results.

Table 1

Mass of carbon dioxide produced in g				
Student 1	**Student 2**	**Student 3**	**Student 4**	**Mean**
0.97	0.91	0.50	0.95	**X**

0 1 . 6 What is the most likely reason for **Student 3**'s anomalous result?

[1 mark]

Tick (✓) **one** box.

The student heated more than 2.00 g of magnesium carbonate. ☐

The student heated the magnesium carbonate for less than 10 minutes. ☐

The student used a higher temperature. ☐

0 1 . 7 Calculate value **X** in **Table 1**.

Do **not** use the anomalous result.

Give your answer to 2 significant figures.

[3 marks]

X (2 significant figures) = _____ g

10

Do not write outside the box

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 2 This question is about electrolysis.

0 2 . 1 Complete the sentence.

Choose the answer from the box.

[1 mark]

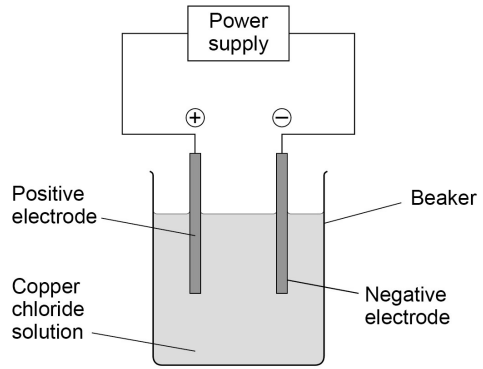
gaseous	**molten**	**solid**

Copper chloride can conduct electricity when in solution or

when _____ .

Figure 1 shows the apparatus used for the electrolysis of copper chloride solution.

Figure 1



There are four ions in copper chloride solution:

- Cu^{2+}
- Cl^{-}
- H^{+}
- OH^{-}

Do not write outside the box

0 2 . 2 Why do Cl^- ions and OH^- ions move to the positive electrode?

[1 mark]

0 2 . 3 Where do the H^+ and OH^- ions come from in the electrolysis of copper chloride solution?

[1 mark]

Tick (✓) **one** box.

Air ☐

Copper chloride ☐

Water ☐

0 2 . 4 Which ion produces a metal?

[1 mark]

Tick (✓) **one** box.

Cu^{2+} ☐

Cl^- ☐

H^+ ☐

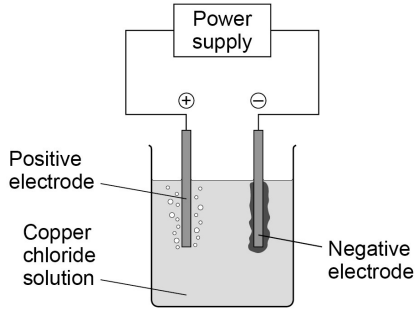
OH^- ☐

Question 2 continues on the next page

Do not write outside the box

0 2 . 5 **Figure 2** shows the apparatus during the electrolysis of copper chloride solution.

Figure 2



Describe what is seen at each electrode during the electrolysis of copper chloride solution.

[2 marks]

Positive electrode _____

_____

Negative electrode _____

_____

0 2 . 6 500 cm^3 of copper chloride solution contains 6.50 g of copper chloride.

Calculate the mass of copper chloride in 40.0 cm^3 of this copper chloride solution.

[2 marks]

_____

_____

_____

Mass = _____ g

8

0 3 Carbon can exist in a number of different structures.

0 3 . 1 What is the approximate radius of a carbon atom?

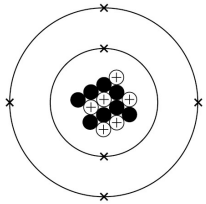
[1 mark]

Tick (✓) **one** box.

0.1 m ☐ 0.1 mm ☐ 0.1 nm ☐

0 3 . 2 **Figure 3** shows an atom of carbon.

Figure 3



Describe the atomic structure of this carbon atom.

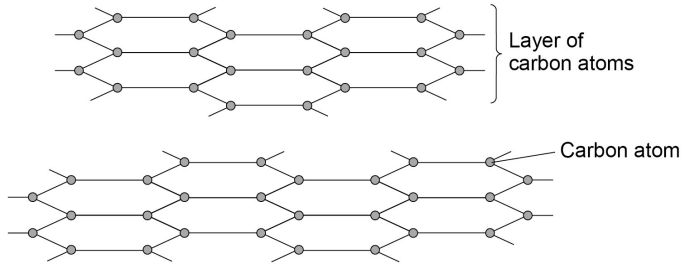
You should include the number of electrons, neutrons and protons.

[6 marks]

In graphite the carbon atoms are held together by bonds.

Figure 4 represents part of the structure of graphite.

Figure 4



0 3 . 3 How many bonds does each carbon atom have in graphite?

Use **Figure 4**.

[1 mark]

Tick (✓) **one** box.

1 ☐ 2 ☐ 3 ☐ 4 ☐

0 3 . 4 What type of bonds hold the carbon atoms together in graphite?

[1 mark]

Tick (✓) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

Do not write outside the box

0 3 . 5 Lubricants allow objects to slide over each other easily.

Suggest why graphite can be used as a lubricant.

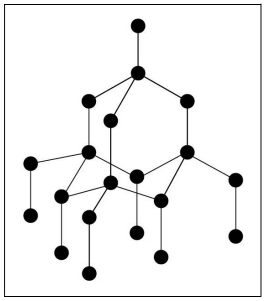
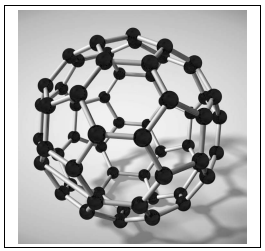
Use **Figure 4.**

[1 mark]

0 3 . 6 The two structures represent different forms of carbon.

Draw **one** line from each structure to the form of carbon.

[2 marks]

Structure	Form of carbon
	Buckminsterfullerene
	Diamond
	Graphene
	Nanotube

12

Do not write outside the box

0 4 Sodium and potassium are Group 1 elements.

0 4 . 1 What is the name of Group 1 elements?

[1 mark]

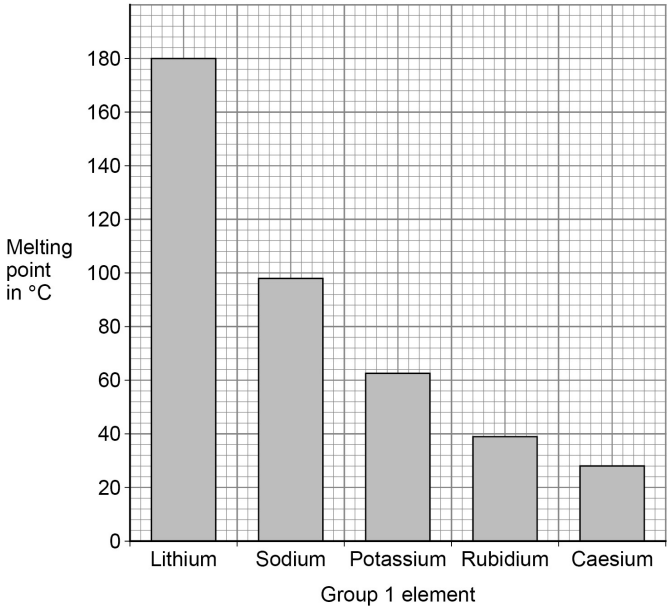
Tick (✓) **one** box.

- Alkali metals ☐
- Halogens ☐
- Noble gases ☐

Do not write outside the box

0 4 . 2 **Figure 5** represents the melting points of Group 1 elements.

Figure 5



What is the melting point of sodium?

[1 mark]

Melting point of sodium = _____ °C

0 4 . 3 Sodium reacts with water to produce sodium hydroxide and hydrogen.

Balance the equation for the reaction.

[1 mark]

$$\_\_\_\_ Na + 2H_2O \rightarrow 2NaOH + H_2$$

Turn over ►

Do not write outside the box

0 4 . 4 Calculate the relative formula mass (M_r) of sodium hydroxide (NaOH).

Relative atomic masses (A_r): H = 1 O = 16 Na = 23

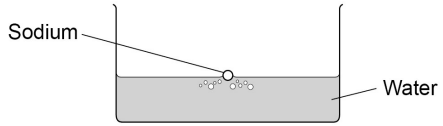
[2 marks]

Relative formula mass (M_r) = _____

0 4 . 5 Sodium and potassium both react with water.

Figure 6 shows sodium reacting with water.

Figure 6



Compare what is seen when sodium reacts with water and when potassium reacts with water.

[4 marks]

9

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

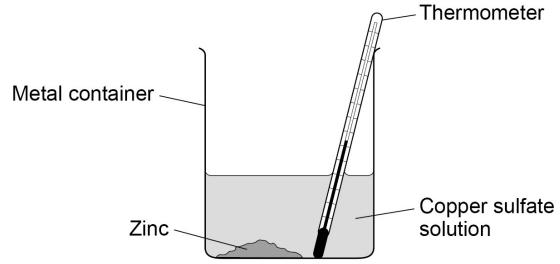
0 5 A student investigated the change in temperature when different masses of zinc were added to copper sulfate solution.

This is the method used.

1. Measure the volume of copper sulfate solution using a measuring cylinder.
2. Pour the copper sulfate solution into a metal container.
3. Add 2 g of zinc.
4. Measure the temperature of the solution.
5. Repeat steps 1 to 4 with different masses of zinc.

Figure 7 shows the apparatus.

Figure 7



0 5 . 1 Give **three** improvements to the investigation to make the results more accurate.
[3 marks]

1 _____

_____

2 _____

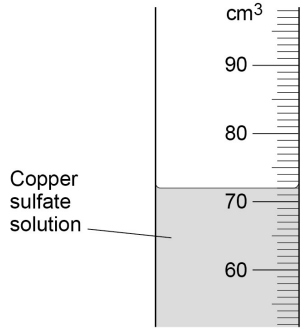
_____

3 _____

_____

0 5 . 2 **Figure 8** shows part of the measuring cylinder.

Figure 8



What is the volume of copper sulfate solution in **Figure 8**?

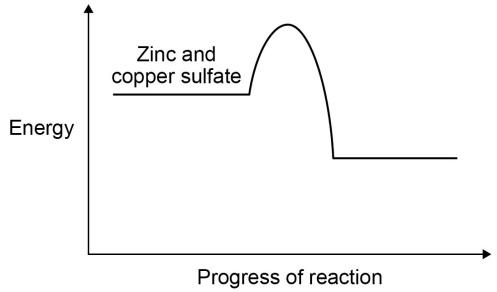
[1 mark]

Volume = _____ cm^3

0 5 . 3 When zinc was added to copper sulfate solution the temperature increased.

Figure 9 shows the reaction profile.

Figure 9



What type of reaction is shown in **Figure 9**?

[1 mark]

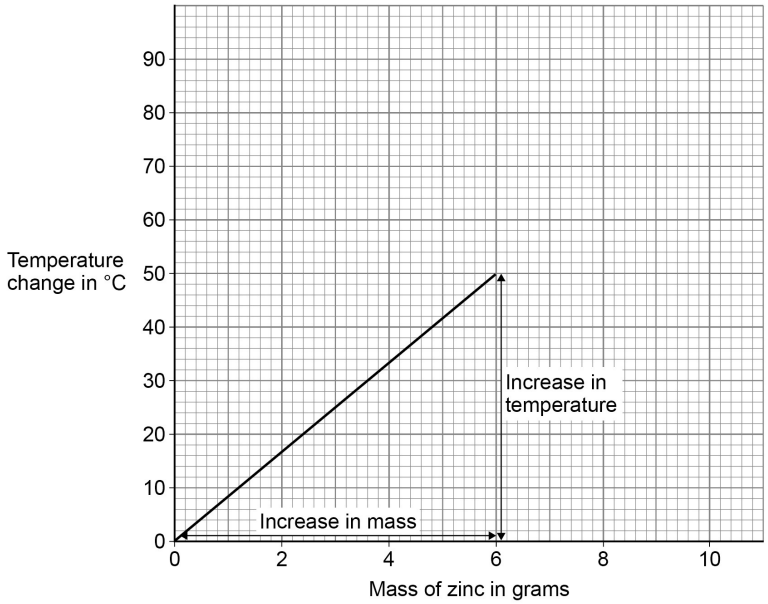
Tick (✓) **one** box.

Endothermic ☐ Exothermic ☐ Neutralisation ☐

Turn over ►

Figure 10 shows the results.

Figure 10



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0 5 . 4 Determine the gradient of the line in **Figure 10.**

Use the equation:

$$\text{gradient} = \frac{\text{increase in temperature in °C}}{\text{increase in mass in grams}}$$

[4 marks]

Gradient = _____ °C per g

0 5 . 5 Suggest why the student should **not** use more than 10 g of zinc.

Use **Figure 10.**

You should extend the graph line.

[2 marks]

11

Turn over for the next question

Do not write outside the box

0 6 This question is about the periodic table.

0 6 . 1 **Figure 11** shows part of Mendeleev's version of the periodic table.

Figure 11

H							
Li	Be	B	C	N	O	F	
Na	Mg	Al	Si	P	S	Cl	
K Cu	Ca Zn		Ti	V As	Cr Se	Mn Br	Fe Co Ni
Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	I	Ru Rh Pd

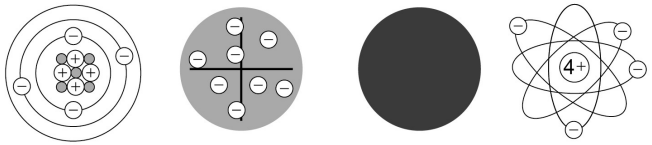
Which group of elements had **not** been discovered when Mendeleev's version of the periodic table was published?

[1 mark]

Do not write outside the box

Figure 12 represents different models of the atom.

Figure 12



A B C D

0 6 . 2 Which model represents the plum pudding model?

[1 mark]

Tick (✓) **one** box.

A ☐ B ☐ C ☐ D ☐

0 6 . 3 Which model resulted from Chadwick's experimental work?

[1 mark]

Tick (✓) **one** box.

A ☐ B ☐ C ☐ D ☐

Question 6 continues on the next page

Do not write outside the box

Potassium has different isotopes.

0 6 . 4 What is meant by 'isotopes'?

You should refer to subatomic particles.

[2 marks]

0 6 . 5 **Table 2** shows the mass numbers and the percentage abundance of two isotopes of potassium.

Table 2

Mass number	Percentage abundance
39	93.1
41	6.9

Calculate the relative atomic mass (A_r) of potassium.

Give your answer to 1 decimal place.

[3 marks]

Relative atomic mass (1 decimal place) = _____

8

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 7 Acids react to produce salts.

Universal indicator is added to water and then nitric acid is added to the mixture.

0 7 . 1 Give the colour change when nitric acid is added to the mixture of universal indicator and water.

[1 mark]

Tick (✓) **one** box.

- Blue to red ☐
- Green to purple ☐
- Green to red ☐
- Red to purple ☐

0 7 . 2 What happens to the pH of water when nitric acid is added?

[1 mark]

Tick (✓) **one** box.

- Decreases ☐
- Stays the same ☐
- Increases ☐

0 7 . 3 What is the state symbol for nitric acid?

[1 mark]

_____

Do not write outside the box

Zinc carbonate reacts with nitric acid.

The word equation for the reaction is:

zinc carbonate + nitric acid → zinc nitrate + water + carbon dioxide

white solid — colourless solution

0 7 . 4 Give **two** observations that would be made when zinc carbonate is added to nitric acid until the zinc carbonate is in excess.

[2 marks]

1 _____

_____

2 _____

_____

0 7 . 5 The formula of the zinc ion is Zn^{2+}

The formula of the nitrate ion is NO_3^-

What is the formula for zinc nitrate?

[1 mark]

Tick (✓) **one** box.

$ZnNO_3$ ☐

$Zn(NO_3)_2$ ☐

Zn_2NO_3 ☐

$Zn_2(NO_3)_2$ ☐

Question 7 continues on the next page

Do not write outside the box

0 7 . 6 Acids react with insoluble metal oxides to produce salts.

Plan a method to produce a pure, dry sample of the soluble salt copper chloride from an acid and a metal oxide.

[6 marks]

_____

_____

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END OF QUESTIONS

12

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ANSWER IN THE SPACES PROVIDED

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Question number	**Additional page, if required. Write the question numbers in the left-hand margin.**

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ANSWER IN THE SPACES PROVIDED

AQA

GCSE
COMBINED SCIENCE: TRILOGY
8464/C/1F

Chemistry Paper 1F

Mark scheme

June 2021

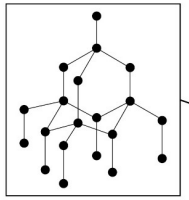
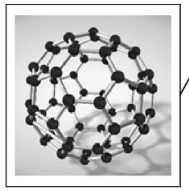
Version: 1.0 Final Mark Scheme

216G8464C1F/MS

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	a metal and a non-metal		1	AO1 5.1.2.1 5.1.2.3 5.3.1.1
01.2	magnesium + chlorine → magnesium chloride	allow Mg for magnesium allow Cl_2 for chlorine allow $MgCl_2$ for magnesium chloride	1	AO2 5.1.1.1 5.1.2.6
01.3	balance		1	AO1 5.3.1.3
01.4	more than 1.0 g		1	AO3 5.3.1.3 5.4.1.1
01.5	(% =) $\frac{24}{40} \times 100$ = 60 (%)		1 1	AO2 5.3.1.2
01.6	the student heated the magnesium carbonate for less than ten minutes		1	AO3 5.3.1.3
01.7	$\frac{0.97 + 0.91 + 0.95}{3}$ **or** $\frac{2.83}{3}$ = 0.943333 (g) = 0.94 (g)	allow for **1** mark $\frac{0.97 + 0.91 + 0.50 + 0.95}{4}$ **or** $\frac{3.33}{4}$ = 0.8325 (g) allow an answer correctly rounded to 2 significant figures using values from the table	1 1 1	AO3 AO2 AO2 5.3.1.3
Total			**10**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	molten		1	AO2 5.2.3.2 5.4.3.1 5.4.3.2
02.2	opposite (charges) attract **or** (the ions) are negative(ly charged)		1	AO1 5.4.3.1 5.4.3.4 RPA9
02.3	water		1	AO1 5.4.3.4
02.4	Cu^{2+}		1	AO2 5.4.3.1 5.4.3.4 RPA9
02.5	(positive electrode) bubbles / effervescence / fizzing (negative electrode) (pink / orange / red / brown) solid	 allow gas (is produced) allow copper (plating) allow metal for solid	 1 1	AO3 5.4.3.1 5.4.3.4 RPA9
02.6	$\frac{40.0}{500} \times 6.50$ = 0.52 (g)		1 1	AO2 5.1.2.6 5.3.2.5
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	0.1 nm		1	AO1 5.1.1.5
03.2	6 protons 8 neutrons 6 electrons protons in nucleus neutrons in nucleus electrons (around nucleus) in energy levels / shells	 allow electron (structure) 2,4 	1 1 1 1 1 1	AO2 AO2 AO2 AO1 AO1 AO1 5.1.1.4 5.1.1.5 5.1.1.7
03.3	3		1	AO1 5.2.2.6 5.2.3.2
03.4	covalent		1	AO1 5.2.2.6 5.2.3.2
03.5	layers slide (over each other)	allow atoms slide over each other	1	AO3 5.2.3.2

03.6	**Structure** **Form of carbon**   Buckminsterfullerene Diamond Graphene Nanotube do **not** accept more than **one** line from a box on the left	1 1	AO1 5.2.3.1 5.2.3.3
Total		**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	alkali metals		1	AO1 5.1.2.5
04.2	98 (°C)	allow a value in the range 97–99 (°C)	1	AO2 5.1.2.5
04.3	$2Na + 2H_2O \rightarrow 2NaOH + H_2$	allow multiples	1	AO2 5.1.2.5 5.4.1.1
04.4	(M_r =) 23 + 16 + 1 = 40		1 1	AO2 5.1.2.5 5.3.1.2

Question	Answers	Mark	AO / Spec. Ref.
04.5	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	3–4	AO1 AO2
	Level 1: Relevant features are identified and differences noted.	1–2	AO1
	No relevant content	0	
	Indicative Content: <u>Similarities – sodium and potassium both:</u> • float • move • bubble / effervesce / fizz • melt • form a ball • get smaller **or** disappear <u>Differences – potassium:</u> • moves faster • bubbles faster • reacts faster • disappears faster • catches fire • lilac flame		5.1.2.5
Total		**9**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	any **three** from: • use a (glass) beaker **or** use a polystyrene cup • insulate the metal container • add a lid • measure copper sulfate solution with a pipette • use same volume (of copper sulfate solution) • use a more accurate balance • stir (the mixture) • record the initial **and** the highest temperature • use a digital thermometer **or** use a more accurate thermometer • repeat the experiment **and** calculate the mean (ignoring anomalous results)		3	AO3 5.5.1.1
05.2	72 (cm^3)		1	AO2 5.4.3.1 5.4.3.4 RPA9
05.3	exothermic		1	AO2 5.5.1.2

05.4	(increase in temperature =) 50 (°C) increase in mass = 6 (g) (gradient =) $\frac{50}{6}$ = 8.33 (°C per g)	 allow a value in the range 5.8 – 6 (g) allow correct use of incorrectly determined value(s) for temperature and/or mass 	1 1 1 1	AO2 5.4.3.1 5.4.3.4 RPA9
05.5	extends line on graph to 10 g of zinc any **one** from: • temperature (change) of 84 (°C) • (so the solution will be) too hot • (so the solution will be) over 100 (°C) • (so the solution will) boil	 allow a temperature (change) over 80 (°C)	1 1	AO2 AO3 5.4.3.1 5.4.3.4 RPA9
Total			**11**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	(Group) 0 **or** noble gases		1	AO2 5.1.2.2
06.2	B		1	AO2 5.1.1.3
06.3	A		1	AO3 5.1.1.3
06.4	(atoms with the) same number of protons (but with) different numbers of neutrons	allow atoms with the same atomic number allow atoms of the same element ignore the same number of electrons ignore (but with) different mass numbers do **not** accept (but with) different relative atomic mass	1 1	AO1 5.1.1.5
06.5	$\frac{(39 \times 93.1) + (41 \times 6.9)}{100}$ = 39.138 = 39.1	 allow correctly rounded answer to **1** decimal place from an incorrect calculation using all the values given in the question	1 1 1	AO2 5.1.1.6
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	green to red		1	AO1 5.4.2.4
07.2	decreases		1	AO1 5.4.2.4
07.3	(aq)	allow aq ignore aqueous ignore HNO_3	1	AO1 5.2.2.2
07.4	any **two** from: • (white) solid disappears • fizzing **or** bubbles (of gas) **or** effervescence • (then) stops fizzing • (white) solid left at the end / bottom	 allow a gas is produced ignore colourless solution	2	AO3 5.4.2.2 5.4.2.3
07.5	$Zn(NO_3)_2$		1	AO2 5.1.1.1 5.4.2.2

Question	Answers	Mark	AO / Spec. Ref.
07.6	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 5.4.2.2 5.4.2.3 RPA8
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative Content: • react hydrochloric acid • (with) copper oxide • in a suitable container • warm (hydrochloric) acid • add copper oxide • until is in excess **or** until solid remains • stir • filter excess copper oxide • pour solution / filtrate into evaporating basin • use of water bath **or** use of electric heater • to heat gently **or** partially evaporate • leave to cool / crystallise For level 3 the correct chemicals must have been selected.		
Total		**12**	

AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: TRILOGY

F

Foundation Tier
Chemistry Paper 1F

Time allowed: 1 hour 15 minutes

Materials
For this paper you must have:
- a ruler
- a scientific calculator
- the periodic table (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Do not write outside the box

0 1 This question is about Group 1 elements.

0 1 . 1 What are the Group 1 elements known as?

[1 mark]

Tick (✓) **one** box.

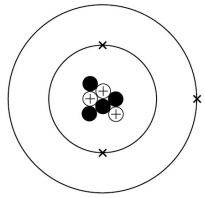
Alkali metals ☐

Halogens ☐

Noble gases ☐

0 1 . 2 **Figure 1** shows a lithium atom.

Figure 1



What is the number of electrons and neutrons in the atom of lithium?

[2 marks]

Number of electrons _____

Number of neutrons _____

0 1 . 3 What is the relative charge on a lithium ion?

[1 mark]

Tick (✓) **one** box.

+1 ☐ 0 ☐ –1 ☐

Do not write outside the box

0 1 . 4 Lithium is heated and then cooled in an experiment.

Lithium solid —Stage **1**→ Lithium liquid —Stage **2**→ Lithium solid

Two physical changes happen in the experiment.

Draw **one** line from each stage to the physical change that happens in that stage.

[2 marks]

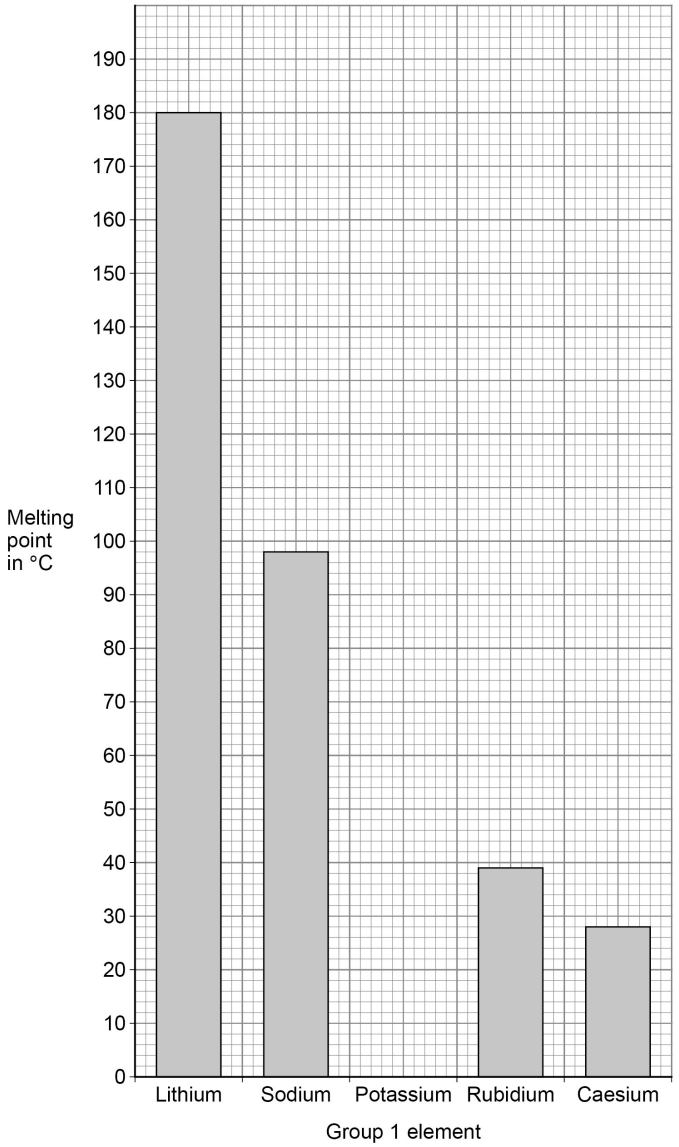
Stage	**Physical change**
	Boiling
	Condensing
Stage **1**	
	Dissolving
Stage **2**	
	Freezing
	Melting

Question 1 continues on the next page

Do not write outside the box

Figure 2 represents the melting points of some Group 1 elements.

Figure 2



Do not write outside the box

0 1 . 5 What is the melting point of caesium?

Use **Figure 2.**

[1 mark]

Melting point = _____ °C

0 1 . 6 The melting point of potassium is 63 °C

Draw a bar for the melting point of potassium on **Figure 2.**

[1 mark]

0 1 . 7 Describe the trend of the melting points of the Group 1 elements in **Figure 2.**

[3 marks]

_____

_____

_____

_____

_____

_____

0 1 . 8 The boiling point of sodium is 883 °C

What is the state of sodium at 150 °C?

Use **Figure 2.**

[1 mark]

Tick (✓) **one** box.

Gas ☐

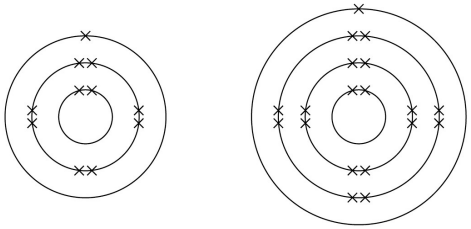
Liquid ☐

Solid ☐

Do not write outside the box

0 1 . 9 **Figure 3** represents the electronic structure of a sodium atom and of a potassium atom.

Figure 3



Sodium atom Potassium atom

Complete the sentence.

Choose the answer from the box.

[1 mark]

gains an electron	**loses an electron**	**shares an electron**

Potassium is more reactive than sodium because potassium more

easily _____ .

13

Do not write outside the box

0 2 This question is about hydrogen chloride and sodium hydroxide.

0 2 . 1 A chlorine atom has 7 electrons in the outer shell.

A hydrogen atom has 1 electron in the outer shell.

Figure 4 represents part of a dot and cross diagram for a molecule of hydrogen chloride.

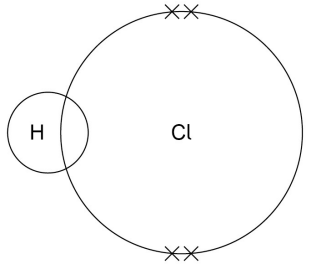
Complete the dot and cross diagram.

Use dots (o) and crosses (x) to represent electrons.

You should show only the electrons in the outer shells.

[2 marks]

Figure 4



0 2 . 2 Hydrogen chloride dissolves in water to produce hydrochloric acid.

Hydrochloric acid reacts with sodium hydroxide solution.

Complete the word equation for the reaction between hydrochloric acid and sodium hydroxide.

[1 mark]

hydrochloric acid + sodium hydroxide → _____ + water

Question 2 continues on the next page

Do not write outside the box

Solutions of hydrochloric acid and sodium hydroxide are reacted and the temperature change is recorded.

0 2 . 3 In the reaction, 3.65 g of hydrogen chloride reacts with 4.00 g of sodium hydroxide.

1.80 g of water is produced.

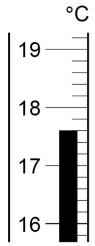
Calculate the mass of the other product.

[1 mark]

Mass = _____ g

0 2 . 4 **Figure 5** shows part of the thermometer used to measure the temperature.

Figure 5



What is the temperature reading on the thermometer?

[1 mark]

Temperature = _____ °C

0 2 . 5 In the reaction, the temperature increases.

What type of reaction is happening when the temperature increases?

[1 mark]

0 2 . 6 Sodium hydroxide is an alkali.

Which **two** ions are in sodium hydroxide solution?

[2 marks]

Tick (✓) **two** boxes.

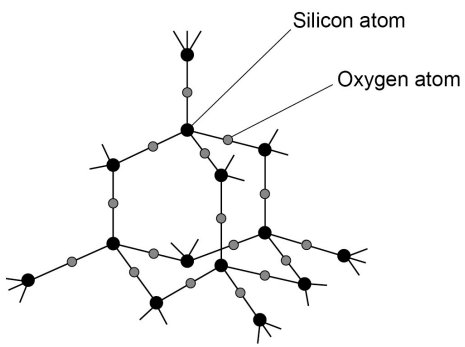
Cl^- ☐ H^+ ☐ Na^+ ☐ O^{2-} ☐ OH^- ☐

8

0 3 This question is about structure and bonding.

Figure 6 represents part of the structure of silicon dioxide.

Figure 6



0 3 . 1 What type of structure is silicon dioxide?

[1 mark]

Tick (✓) **one** box.

Giant covalent ☐

Ionic lattice ☐

Simple molecular ☐

0 3 . 2 Each oxygen atom forms two bonds.

What is the number of bonds formed by each silicon atom?

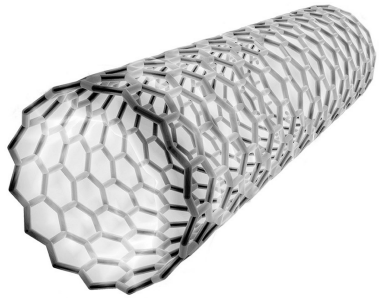
Use **Figure 6**.

[1 mark]

_____

Figure 7 represents part of a fullerene.

Figure 7



0 3 . 3 Complete the sentence.

Choose the answer from the box.

[1 mark]

hexagons	octagons	squares	triangles

The structure of fullerenes is based on _____ .

0 3 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

carbon	hydrogen	oxygen

The fullerene molecule shown in **Figure 7** is made from

atoms of _____ .

Do not write outside the box

0 3 . 5 What is the fullerene molecule shown in **Figure 7** used for?

[1 mark]

Tick (✓) **one** box.

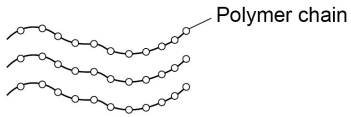
- Electronics ☐
- Hand warmers ☐
- Sports injury packs ☐

Question 3 continues on the next page

Do not write outside the box

Figure 8 represents part of the structure of a polymer.

Figure 8



0 3 . 6 What holds the atoms together in a polymer chain?

[1 mark]

Tick (✓) **one** box.

- Covalent bonds ☐
- Ionic bonds ☐
- Metallic bonds ☐

0 3 . 7 Complete the sentence.

Choose the answer from the box.

[1 mark]

atomic	**intermolecular**	**macromolecular**

In **Figure 8** the polymer chains are held together by

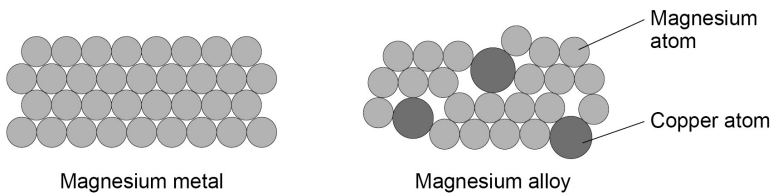
_____ forces.

Do not write outside the box

Figure 9 represents part of the structures of:

- magnesium metal
- a magnesium alloy.

Figure 9



0 3 . 8 Calculate the percentage of copper atoms in the alloy.

[3 marks]

Number of magnesium atoms in the alloy = _____

Number of copper atoms in the alloy = _____

Total number of atoms in the alloy = _____

_____

Percentage of copper atoms in the alloy = _____ %

0 3 . 9 Explain why the magnesium alloy is harder than magnesium metal.

Use **Figure 9**.

[3 marks]

_____

_____

_____

_____

_____

_____

13

Turn over ►

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 4 This question is about elements and compounds.

0 4 . 1 Magnesium and oxygen react to produce magnesium oxide.

Balance the equation for the reaction.

[1 mark]

$$\_\_\_\_\_ Mg + O_2 \rightarrow 2\,MgO$$

0 4 . 2 Suggest **one** safety precaution that should be taken when heating magnesium and oxygen.

[1 mark]

0 4 . 3 Calculate the relative formula mass (M_r) of magnesium fluoride (MgF_2).

Relative atomic masses (A_r): F = 19 Mg = 24

[2 marks]

Relative formula mass (M_r) = _____

0 4 . 4 Argon is a noble gas.

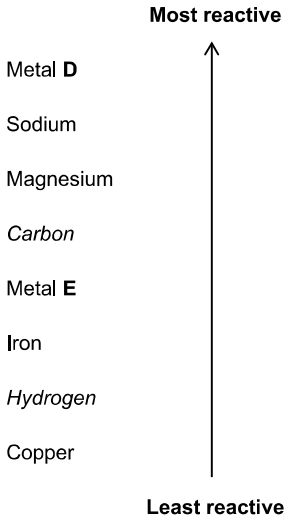
Explain why **no** product is formed when magnesium and argon are heated together.

[2 marks]

Do not write outside the box

0 4 . 5 **Figure 10** shows a reactivity series.

Figure 10



Do not write outside the box

Draw **one** line from each metal to the method used to extract that metal.

Use **Figure 10.**

[2 marks]

Metal	Method used to extract that metal
	Extracted by electrolysis of a molten ionic compound.
Metal **D**	Extracted from its oxide by reduction with carbon.
	Extracted from its oxide by reduction with hydrogen.
Metal **E**	
	Removed from the Earth as the metal itself.

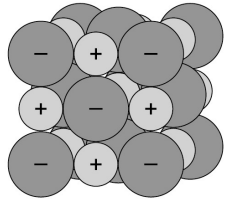
Question 4 continues on the next page

Do not write outside the box

A substance conducts electricity when it has charged particles that are free to move.

0 4 . 6 **Figure 11** represents the structure of sodium chloride.

Figure 11



Sodium chloride

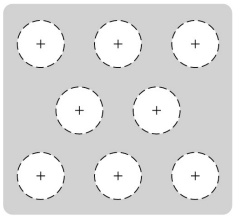
Explain why sodium chloride conducts electricity when molten but **not** when solid.

[3 marks]

Do not write outside the box

0 4 . 7 **Figure 12** represents the structure of sodium metal.

Figure 12



Sodium metal

Explain why sodium metal conducts electricity when solid.

[2 marks]

13

Turn over for the next question

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

0 5 This question is about salts.

Green copper carbonate and sulfuric acid can be used to produce blue copper sulfate crystals.

0 5 . 1 **Excess** copper carbonate is added to sulfuric acid.

Give **three** observations you would make.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

0 5 . 2 How can the excess copper carbonate be removed?

[1 mark]

_____

_____

0 5 . 3 The pH of the solution changes during the reaction.

What is the pH of the solution at the end of the reaction?

[1 mark]

pH = _____

0 5 . 4 Copper carbonate and sulfuric acid react to produce copper sulfate.

What type of reaction is this?

[1 mark]

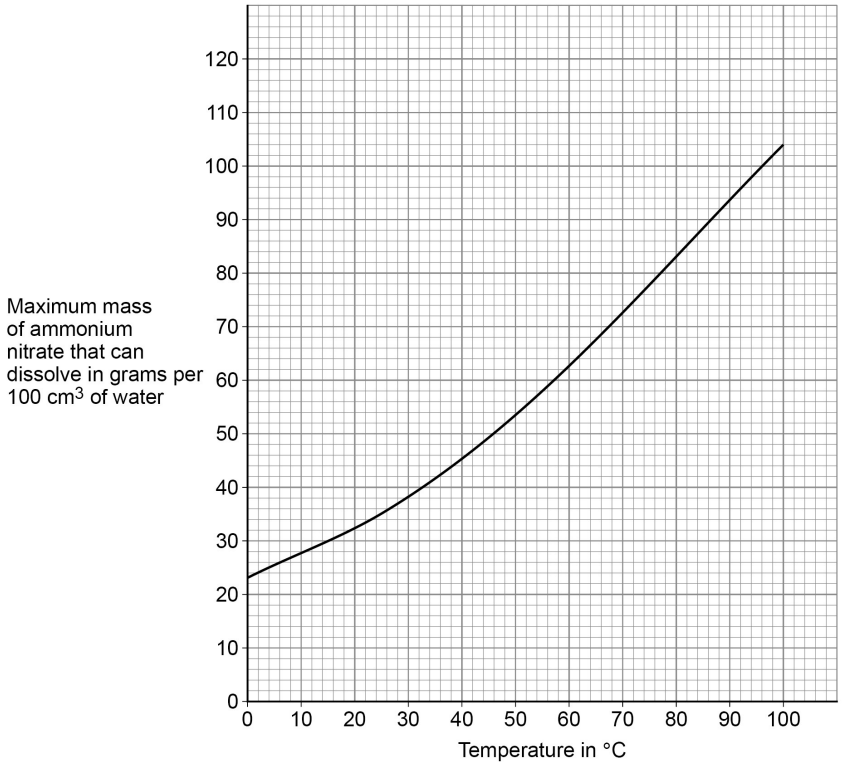
_____

Turn over ►

0 5 . 5 Ammonium nitrate is a salt.

Figure 13 shows the maximum mass of ammonium nitrate that can dissolve in 100 cm^3 of water at different temperatures.

Figure 13



Do not write outside the box

A student adds ammonium nitrate to water at 80 °C until no more dissolves.

The student cools 100 cm^3 of this solution of ammonium nitrate from 80 °C to 20 °C to produce crystals of ammonium nitrate.

Determine the mass of ammonium nitrate that crystallises on cooling 100 cm^3 of this solution from 80 °C to 20 °C

[3 marks]

Mass = _____ g

9

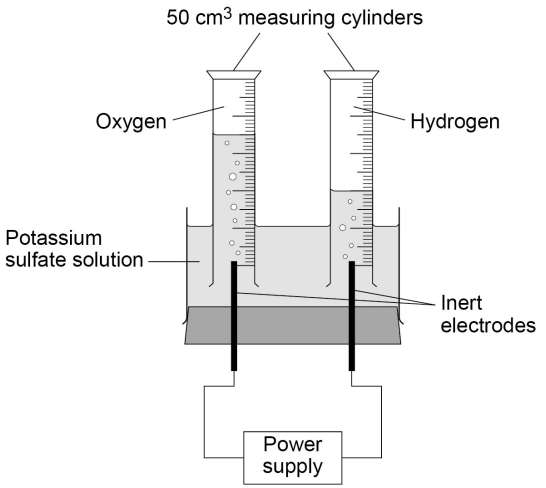
Turn over for the next question

Do not write outside the box

0 6 This question is about electrolysis.

Figure 14 shows the apparatus used to investigate the electrolysis of potassium sulfate solution.

Figure 14



0 6 . 1 Potassium sulfate contains K^+ and SO_4^{2-} ions.

What is the formula of potassium sulfate?

[1 mark]

Tick (✓) **one** box.

KSO_4 ☐

K_2SO_4 ☐

$K(SO_4)_2$ ☐

$K_2(SO_4)_2$ ☐

Do not write outside the box

0 6 . 2 What are the volumes of gases collected in the electrolysis experiment?

Use **Figure 14.**

[1 mark]

Volume of hydrogen = _____ cm^3

Volume of oxygen = _____ cm^3

0 6 . 3 A student made the following hypothesis:

'The volumes of gases collected in this electrolysis experiment are in the same ratio as hydrogen atoms to oxygen atoms in a water molecule.'

Explain how the volumes of gases collected in the experiment in **Figure 14** support the student's hypothesis.

Use your answer to Question **06.2**

[2 marks]

Question 6 continues on the next page

Do not write outside the box

0 6 . 4 The experiment is repeated 4 times.

The volumes of oxygen collected in the 4 experiments are:

6 cm^3 9 cm^3 10 cm^3 11 cm^3

The mean volume of oxygen collected in the 4 experiments is 9 cm^3

The measure of uncertainty is the range of a set of measurements about the mean.

What is the measure of uncertainty in the 4 experiments?

[1 mark]

Tick (✓) **one** box.

9 ± 1 cm^3 ☐

9 ± 2 cm^3 ☐

9 ± 3 cm^3 ☐

0 6 . 5 The potassium sulfate solution has 0.86 g of potassium sulfate dissolved in 25 cm^3 of water.

Calculate the mass of potassium sulfate needed to make 1.0 dm^3 of solution.

[3 marks]

Mass = _____ g

8

Do not write outside the box

0 7 Plan an investigation to find the order of reactivity of three metals.

You should use the temperature change when each metal reacts with hydrochloric acid.

[6 marks]

6

END OF QUESTIONS

Do not write outside the box

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ANSWER IN THE SPACES PROVIDED

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Question number	**Additional page, if required. Write the question numbers in the left-hand margin.**

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ANSWER IN THE SPACES PROVIDED

AQA

GCSE
COMBINED SCIENCE: TRILOGY
8464/C/1F

Chemistry Paper 1F

Mark scheme

June 2022

Version: 1.0 Final Mark Scheme

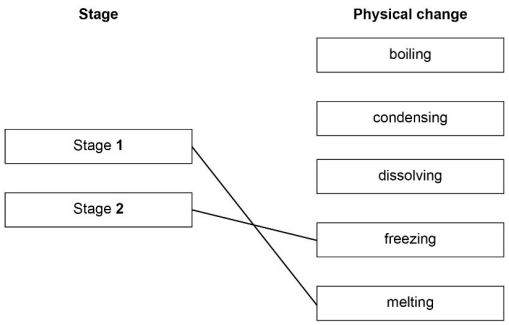
2 2 6 G 8 4 6 4 C 1 F / M S

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	alkali metals		1	AO1 5.1.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	3 / three 4 / four	must be in this order	1 1	AO2 5.1.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	+1		1	AO2 5.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	 do **not** accept more than one line from a box on the left		1 1	AO1 5.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	28 (°C)		1	AO2 5.1.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	bar plotted at 63 °C	allow a tolerance of ± ½ a small square	1	AO3 5.1.2.5

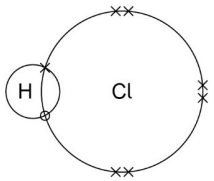
Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	(melting point) decreases as go down Group 1	allow converse in terms of increasing melting point ignore boiling points allow **1** mark for (melting point) decreases	2	AO1
	(and the) differences get smaller **or** initial drop is largest		1	AO3 5.1.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.8	liquid		1	AO3 5.1.2.5 5.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.9	loses an electron		1	AO1 5.1.1.7 5.1.2.1 5.1.2.5

Total Question 1		**13**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1		allow any combination of circles, dots, crosses or $e^{(-)}$		AO1 5.1.2.6 5.2.1.4
	one shared pair in overlap		1	
	6 non-bonding electrons in outer shell of chlorine	do **not** accept extra electron(s) on outer shell of hydrogen ignore any inner shell electrons an answer of  scores **2** marks	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	sodium chloride	allow NaCl	1	AO2 5.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	5.85 (g)		1	AO2 5.3.1.1 5.4.2.2 5.5.1.1 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	17.6 (°C)		1	AO2 5.4.2.2 5.5.1.1 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	exothermic (reaction)	allow neutralisation (reaction)	1	AO2 5.5.1.1 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	Na^+		1	AO1 AO2 5.4.2.2 5.4.2.4 5.5.1.1
	OH^-		1	

Total Question 2		8

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	giant covalent		1	AO1 5.2.2.6 5.2.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	4 / four		1	AO3 5.2.2.6 5.2.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	hexagons		1	AO1 5.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	carbon		1	AO1 5.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	electronics		1	AO1 5.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	covalent bonds		1	AO1 5.2.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	intermolecular		1	AO1 5.2.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.8	(magnesium) 22 **and** (copper) 3 (percentage =) $\frac{3}{25}$ (× 100) =12 (%)	allow correct use of incorrectly determined value(s) for number of magnesium atoms and / or copper atoms	1 1 1	AO2 5.2.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.9	(alloy is harder because) copper atoms are larger **or** (copper) atoms are a different size		1	AO2
	(so the) layers of (magnesium) atoms are distorted		1	AO2
	(and therefore the) layers cannot easily slide	allow (so) the atoms cannot slide over each other	1	AO1 5.2.1.5 5.2.2.7

Total Question 3		**13**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	**2** Mg + O_2 → 2 MgO	allow multiples	1	AO2 5.1.2.5 5.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	any **one** from: • wear safety glasses / goggles • do not look directly at burning magnesium • wear heat proof glove	allow look through blue glass allow use tongs allow tie hair back	1	AO3 5.4.1.1 5.4.1.2 5.5.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	(M_r =) 24 + (2 × 19) = 62		1 1	AO2 5.1.2.5 5.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	any **one** from: • argon has a full outer shell • argon has 8 electrons in the outer shell • argon has a stable arrangement of electrons.	allow energy level for shell allow does not need to lose and / or gain electrons	1	AO2
	(so) argon is unreactive	ignore argon is a noble gas	1	AO1 5.1.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	**Metal** — **Method used to extract that metal** Metal **D** → Extracted by electrolysis of a molten ionic compound. Metal **D** → Extracted from its oxide by reduction with carbon. Metal **E** → Extracted from its oxide by reduction with hydrogen. Removed from the Earth as the metal itself. do **not** accept more than one line from a box on the left		1 1	AO3 5.4.1.2 5.4.1.3 5.4.3.1 5.4.3.2 5.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	(because) <u>ions</u> (which are) free to move when molten (but are) fixed in solid	 allow reference to charged particles for MP2 and MP3	1 1 1	AO1 5.2.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	(sodium contains) delocalised electrons (which) carry (electrical) charge (through the metal / sodium)	allow free electrons ignore throughout for through ignore current / electricity	1 1	AO1 5.2.2.8

Total Question 4		13

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	any **three** from: • green solid / powder • colourless solution • blue solution formed • copper carbonate disappears • fizzing / effervescence **or** bubbles (of gas) • stops fizzing • solid / powder left at the end **or** copper carbonate left at the end	 ignore green copper carbonate allow colour (of solution) changes allow solid disappears ignore gas allow fizzing slows down allow (container) gets hot **or** allow temperature increases	3	AO2 AO3 5.4.2.2 5.4.2.3 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	filtration **or** filter		1	AO1 5.4.2.3 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	7		1	AO1 5.4.2.3 5.4.2.4 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	neutralisation	allow exothermic	1	AO1 5.4.2.2 5.4.2.4 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	83 (g at 80 °C)	allow a value in range 82–84 (g at 80 °C)	1	AO2
	32 (g at 20 °C)	allow a value in range 32–33 (g at 20 °C)	1	AO2
	(83–32 =) 51 (g)	allow a correct calculation using incorrectly read values for mass at 80 °C and/or 20 °C	1	AO3 5.4.2.3

Total Question 5		**9**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	K_2SO_4		1	AO2 5.1.1.1 5.4.3.4 RPA9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	(volume of hydrogen) 30 (cm^3) **and** (volume of oxygen) 15 (cm^3)		1	AO2 5.4.3.4 RPA9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	(because) the ratio of volume of hydrogen : oxygen is 2 : 1 (and this is the) **same** as the ratio of hydrogen (atoms) : oxygen (atoms) in (formula of) H_2O **OR** (because) the ratio of volume of hydrogen : oxygen is **not** 2 : 1 (1) (and this is) **different** to the ratio of hydrogen (atoms) : oxygen (atoms) in (formula of) H_2O (1)	**must** relate to the volumes given in question **06.2**	1 1	AO3 5.4.3.4 RPA9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	9 ±3 cm^3		1	AO2 5.3.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	(conversion) ($\frac{25}{1000}$ =) 0.025 (dm^3) (concentration =) $\frac{0.86}{0.025}$ = 34.4 (g per dm^3) **OR** (conversion) $\frac{1000}{25}$ (1) = 40 (1) (40 × 0.86) = 34.4 (g per dm^3) (1) **OR** (concentration =) $\frac{0.86}{25}$ (1) = 0.0344 (1) (conversion) (0.0344 × 1000) = 34.4 (g per dm^3) (1)	 allow correct use of incorrect / no conversion allow 34 (g per dm^3) allow correct use of incorrect / no conversion allow 34 (g per dm^3) allow 34 (g per dm^3)	1 1 1	AO2 5.3.2.5 5.4.3.4

Total Question 6		8

Question 7

Question	Answers	Mark	AO / Spec. Ref.
07	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	AO3
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	AO1
	No relevant content.	0	
	Indicative Content • measure volume of (hydrochloric) acid • into a suitable container eg polystyrene cup • measure the initial temperature (of hydrochloric acid) • with a thermometer • add stated mass of one metal • stir • measure the highest temperature reached of the solution **or** measure temperature reached after a set time period • determine the temperature difference • repeat • repeat for each metal • with same mass • in same physical state (powder, lump, etc) • with the same volume and / or concentration of (hydrochloric) acid • use results to arrange metals in order of reactivity • most reactive metal has the largest temperature change to access level 3 there must be an indication of how the temperature change is determined with the same mass of the 3 different metals reacted with the same volume of (hydrochloric) acid		5.1.4.2 RPA2

Total Question 7		**6**